

Appl. No. : 09/460,630
Filed : December 14, 1999

REMARKS

The foregoing amendments and the following remarks are responsive to the August 14, 2003 Office Action. Claim 2 is cancelled and Claims 1, 3, and 13 are amended. Thus, Claims 1, 3-11, and 13 are presented for further consideration. Please enter the amendments and reconsider the claims in view of the following remarks.

Comments on Change of Attorney Docket Number

Please note that the Attorney Docket Number for the present application has been changed from "IMEC87.001CP1" to --FILLF1.001CP1--.

Response to Objection to the Drawings

In the August 14, 2003 Office Action, the Examiner still objects to the drawings as not showing every feature of the invention specified in the claims. The Examiner states that "[t]he figures only show a detection circuitry 32, however, the application has not defined this detection circuitry as an amplifier."

Applicant is submitting herewith Replacement Sheets for Figures 2, 3, and 4 to show the amplifier separate from the rest of the detection circuitry 32. Applicant submits that no new matter is being submitting in the present application by these amended drawings. Applicant respectfully requests that the Examiner withdraw the objection to the drawings and pass the present application to allowance.

Response to Rejection of Claims 1-11 and 13 Under 35 U.S.C. § 112, First Paragraph

In the August 14, 2003 Office Action, the Examiner rejects claims 1-11 and 13 under 35 U.S.C. § 112, first paragraph as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention. In particular, the Examiner states that the specification does not disclose the invention as comprising an amplifier integrated in the pixel structure for amplifying the collected charge.

Applicant respectfully disagrees. An active pixel is a pixel configured with circuitry integrated in the pixel to amplify the charge that is collected on the light sensitive element or component in the pixel, as stated on page 1, lines 21-22 of the present application. The present application points out that the present invention relates to active pixels (page 1, lines 9-10). Therefore, the subject matter of the claims, in particular the amplifier integrated in the pixel structure, was conveyed to one skilled in the art at the time of filing the application. As

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described herein, Applicant has cancelled claim 2. Applicant respectfully requests that the Examiner withdraw the rejection of claims 1, 3-11, and 13 and pass these claims to allowance.

Response to Rejection of Claims 1-11 and 13 Under 35 U.S.C. § 103(a)

In the August 14, 2003 Office Action, the Examiner further rejects claims 1, 4-6, and 9-11 under 35 U.S.C. § 103(a) as being unpatentable over Gowda et al. in view of Chi et al., and claims 2, 3, 7, 8, and 13 under 35 U.S.C. § 103(a) as being unpatentable over Gowda et al. in view of Chi et al. as applied to claims 1, 4-6, and 9-11, and further in view of Kuroda et al.

As described herein, Applicant has amended claim 1 so as to incorporate claim 2, and has cancelled claim 2.

Amended claim 1 now describes an active CMOS pixel structure having an amplifier integrated in the pixel structure and coupled to a detection region for amplifying collected charge, the pixel structure comprising:

- a semiconductor substrate with an insulating layer at its surface,
- a collection region formed in the surface region of the semiconductor substrate,
- a barrier region in the substrate,
- a dual-purpose electrode formed on the insulating layer, extending over both the surface of at least part of the collection region and over at least part of the substrate, the dual-purpose electrode being intended to be driven by a first voltage that causes an electrostatic potential which collects in an area of the collection region beneath the dual-purpose electrode charges generated by electromagnetic radiation and by a second voltage, which is higher than the first voltage, for transferring the charges from the collection region into a detection region.

Gowda discloses a pixel structure as in claim 1, except for the barrier region in the substrate.

Kuroda discloses a CCD image pick-up element provided with a barrier region (13 – see Fig. 3A). The Examiner alleges that the barrier region (13) of Kuroda would be applied by a person skilled in the art to the n-region (58) of Gowda. Applicant respectfully disagrees.

The barrier region in Kuroda is applied because a CCD suffers from smear – see also Kuroda, col. 2, lines 67-68. Smear is the undesirable artifact in CCDs that appears in the picture as a vertical streak above and below a very bright object in a scene. Smear is caused by parasitic light getting into the vertical transfer registers.

In order to prevent this, according to Kuroda, a barrier region is applied. An electric charge 14 which becomes the noise component generating smear, and which is generated in the p-type layer 16 may hardly be introduced to the depletion layer 11 of the CCD. This is because a potential barrier against the charge 14 is formed around the depletion layer 11 of the CCD. The electric charge is discharged to the n-type substrate 15, thus not causing smear.

An active pixel, which is the subject of the present invention, does not suffer from the above smear phenomenon, contrary to CCDs. Therefore, introducing a barrier region to reduce smear in active pixel circuits makes no sense.

If a barrier region as in Kuroda would be introduced into an active pixel as in Gowda, Kuroda teaches that charges would be discharged to the substrate, this substrate being an n-type substrate with on top thereof a p-type layer.

This discharge of charges toward the substrate is not what is desired in active pixels: when using active pixels, it is desired to guide as many charges to the read-out region and the read-out circuitry as possible, in order to obtain a signal which corresponds as good as possible to the amount of generated charges. Otherwise, charges are deliberately removed, and thus lost for read-out.

In the present invention, the barrier region is used for increasing the fill factor of the active pixel (see also the present application at page 4, lines 3-8 and lines 19-21), and thus not for removing smear. The barrier region prevents charges generated underneath it from diffusing into the junctions or other structures of the active pixel's additional electronics. There is no such barrier present underneath the collection region, so it can consequently gather charges that are generated under the other electronic components.

Kuroda does not hint in the direction of using a barrier region in an active pixel. Neither does it hint in the direction of using barrier region with a p-type substrate without n-type layer underneath it for absorbing the removed charges.

The Examiner's objection seems to be a hindsight objection: at the time of filing the present patent application, there was no reason for a person skilled in the art to think about providing an active pixel as in Gowda with a barrier region as in Kuroda. Kuroda teaches to apply the barrier region for reducing smear, which does not occur in active pixels; the present invention teaches to apply a barrier region for increasing the fill factor of the active pixel.

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In view of the above, the present invention is believed to be inventive over the cited prior art. Applicant respectfully requests that the Examiner withdraw the rejections of claims 1, 3-11, and 13, and pass these claims to allowance.

Summary

For the foregoing reasons, Applicant submits that claims 1, 3-11, and 13 are in condition for allowance, and such action is respectfully requested.

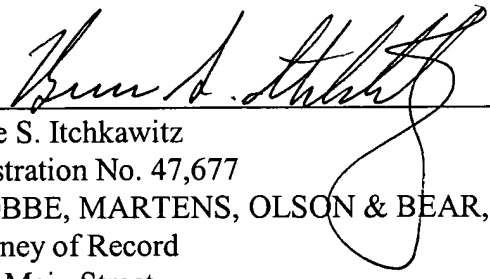
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Respectfully submitted,

Dated: _____

11/12/03

By: _____


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